(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2002 (16.05.2002)

PCT

(10) International Publication Number
WO 02/38858 A2

(51) International Patent Classification[7]: D21F

(21) International Application Number: PCT/FI01/00976

(22) International Filing Date:
9 November 2001 (09.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/246,919 9 November 2000 (09.11.2000) US

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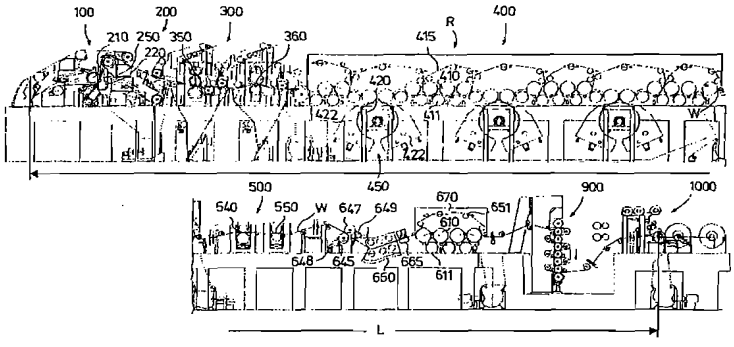
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EC, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** METHOD FOR THE MANUFACTURE OF PAPER, IN PARTICULAR OF COATED FINE PAPER, AND A PAPER MACHINE LINE IN PARTICULAR FOR THE MANUFACTURE OF COATED FINE PAPER



(57) **Abstract:** The present invention relates a method for the manufacture of paper, in particular of coated fine paper, in which method paper stock is fed from a headbox (100) to a wire section (200) in which water is drained from a paper web (W), in which method the paper web (W) is passed from the wire section (200) to a press section (300) to press water out of the paper web (W), and in which method, after the press section (300), the paper web (W) is dried in a dryer section (400), precalendered and coated in a coating station (600), after which the paper web (W) is dried in a drying section (650) and calendered in a final calender (900), and reeled in a reel-up (1000). In the method the stock is fed into the headbox (100) using multilayering technology, the paper web (W) is precalendered in a one or more reinforced-nip calender (500), the paper web (W) is coated in a film coating unit. The invention also relates to a paper machine line in particular for the manufacture of coated fine paper, which line comprises a headbox (100), a wire section (200), a press section (300), a dryer section (400), a precalender (500), a coating station (600) and drying section (680), a final calender (900) and a reel-up (1000). The paper machine line comprises multilayer headbox (100), a one or more reinforced-nip precalender (500), film coating station (600).

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Method for the manufacture of paper, in particular of coated fine paper, and a paper machine line in particular for the manufacture of coated fine paper

The invention relates to a method for the manufacture of paper, in particular of coated fine paper, according to the preamble of claim 1.

The invention also relates to a paper machine line in particular for the manufacture of coated fine paper according to the preamble of claim 10.

By fine paper is usually meant either uncoated fine paper or coated fine paper. The basis weight of uncoated fine paper is usually 40 to 230 g/m^2, that of coated fine paper 60 to 250 g/m^2. Typical pulp for the manufacture of fine paper comprises chemical fibres: short fibres which are obtained, for example, from birch and eucalyptus, and a long-fibre material obtained from softwood trees is generally added to this. The proportion of mechanical pulp is generally below 40 %. About 10 to 30 % of filler is added to the pulp, and the filler may be calcium carbonate, kaolin and/or other suitable mineral pigments. Recently, in the manufacture of fine paper, increasing use has also been made of recycled fibres.

The papermaking line is conventionally designed so that each process step adds certain properties to the paper to achieve a certain quality. For coated paper grades, this target is to create an even and closed paper surface without large variations in pore size. Additionally, the surface smoothness or topography needs to be reduced in order to allow a uniform image to be printed on the paper. This is done by creating a desired base sheet structure before surface treating the sheet (e.g. coating and calendering). In such a way, each process step adds to the final paper quality and also to the required length of the production line. For example, there has been no possibilities to upgrade woodfree papermaking lines with surface sizing capabilities to

produce high quality coated grades without adding surface treating equipment and additional length to the line. Such a rebuild requires additional space in online solutions and especially for offline surface treatment solutions.

The essential quality properties of coated woodfree fine paper include gloss, smoothness, bulk, opacity, and brightness, typically:

- gloss is > 65 % (Hunter),
- smoothness PPS_{10} < 1.3,
- bulk > 0.8 cm^3/g
- opacity > 92 %, and
- brightness > 80 %.

However, all of these quality values are seldom achieved at the same time on fine paper machines according to the state of the art.

In paper or board machines known in prior art, the short circulation and other stock systems are most commonly built such as to mix fibres, fillers, fines and additives to form a stock that is as homogeneous as possible in order to be supplied into a headbox of a paper machine. In multi-layer web forming, it is also known to use several different stock systems for feeding different fibre suspensions into the headbox. In prior art there are also known a short circulation and a headbox allowing layering of additives, fillers and/or fines. One stock feed arrangement of this kind is disclosed in *FI patent application 934793*. Fillers, fines and additives can also be supplied only in the headbox itself. One arrangement of this kind is described in *EP patent publication 0 824157*.

Recently, a novel type of short circulation arrangement has been developed, marketed by the applicant under the trademark **OptiFeed™**, which is described, among other things, in the magazine article *Ein Neuer Ansatz für das Management der Nasspartie, Wochenblatt für Papierfabrikation, vol. 19, No. 20, October 1998*. By using the **OptiFeed™** arrangement, the stock volumes of the short circulation are minimized, which enables, among other things, a fast grade change.

The headbox spreads the formed pulp suspension evenly onto a wire section, in which dewatering and couching of the web begin. In prior art there are known several different types of wire sections, or formers, known in themselves to a person skilled in the art; as fourdrinier formers, hybrid formers, and gap formers. In recent years, in the manufacture of fine paper, a gap former has become common in which a slice jet produced by a headbox is fed between two wires and the bulk of the water is removed between said wires in two directions. One gap former arrangement has been described in the paper read by *L. Verkasalo: Efficient Forming at High Speeds, XI Valmet Paper Technology Days 1998*. In the arrangements known in prior art, the fibre and filler distribution in the thickness direction of the web can be controlled to a limited degree, for example, by means of placement and vacuums of the dewatering elements of the former. The fillers often accumulate on the surfaces of the web in dewatering stages.

In prior art there are also known multi-layer headboxes, one of them having been described, for example, in the paper read by *M. Odell: Multilayering, Method or Madness?, XI Valmet Paper Technology Days 1998* and in *FI patent 92 729*, and one of them having also been described in the paper read by *P. Ahonen: Challenges for Digital Printing Paper, XI Valmet Paper Technology Days 1998*. Multi-layer headboxes allow desired layer structures to be produced in the web by feeding stock in layers between wires.

The web is passed from the wire section to a press section where water is removed from the web by pressing it against one or two felts. A skilled person knows several different press arrangements from prior art, for example, a press based on roll nips, marketed by the applicant under the trademark **SymPress II™**. Recently, instead of roll nips, in the case of all paper and board grades ever-increasing use has been made of an extended nip known in itself in prior art because of its higher dewatering capacity and/or its ability to retain the bulk of the web.

The dryer section in fine paper machines known in prior art has most commonly been formed of a dryer section which uses conventional single- and/or twin-wire draw and in which drying takes place mainly as cylinder drying while the wire presses the web against a heated cylinder surface. At high running speeds, single-wire draw through the entire dryer section has become common in recent years. As the most recent arrangement, for example, the patent application *PCT/FI98/00945* has proposed combining impingement drying with cylinder drying in order to provide a higher evaporation rate and a shorter dryer section.

In several fine paper machines known in prior art, the paper web is passed from the dryer section to a precalender, which in known arrangements may be a calender with hard or soft nips, in which the paper web is passed through the nip between rolls to provide smoothness to the surface of the paper web. Recently, also in the case of fine paper, a so-called soft calender has become common which comprises a soft coated roll and a hot hard-faced thermo roll. In the precalender, loose fibres and other stock components are also fixed to the surface of the web, but, at the same time, differences in density may also be caused in the base paper and some of the bulkiness of the web important to many grades may be lost.

After that, in the fine paper machines known in prior art there is precoating, a surface sizing or pigmenting unit. In surface sizing, the surfaces of the web are treated with a starch or pigment solution in a film size press, for example, by means of an applicator device marketed by the applicant under the trademark **OptiSizer™, SymSizer™**. Surface sizing, pigmenting, or coating is performed at this stage typically on both sides of the web at the same time, but the surfaces of the web can also be treated separately in successive units. After that, the paper web is dried by using infrared dryers and airborne web-dryers as well as a subsequent cylinder group or groups, and the paper web is reeled by means of a machine reel-up.

After that, in the manufacturing process of fine paper according to prior art there is an unwind stand, from which the web is passed to an off-machine coating station.

Different coating devices are known in prior art, such as, for example, coating devices of the blade coating, jet, film transfer or non-contact application techniques such as the spray type. A coating agent is transferred by means of the coating device freely to the surface of the web either as a continuous jet (jet) or as drops (spray) or the coating agent is applied by a roll. In one known arrangement, one side of the paper web is precoated first, after which there is a dryer section, and after that the other side of the paper web is precoated, which is followed by a dryer section. The coating of the thus produced precoated web is completed by coating it with other coating layers and, after that, the web is dried, and wound up. The dryer part of the coating station typically comprises first a unit which is not in contact with the web, for example, an infrared dryer, and a cylinder group located after that. In the end, the web is unwound and calendered by means of a supercalender or a multinip calender with the trademark **OptiLoad™**, which imparts a desired level of smoothness and gloss to the web. Reeling ends the fine paper machine line. One reel-up known in prior art is the reel-up marketed by the applicant under the trademark **OptiReel™**

One problem in the fine paper machines known in prior art is particularly their space requirement because of the long machine, and the fact that the change of grade takes a long time. For example, when a conventional short circulation is used, the change of grade takes about two hours. Moreover, when cylinder drying is used, because of the high heat capacity of the cylinders, the changing of heating power is a slow process.

An object of the invention is to provide a method and a paper machine for fine paper, in particular for CWF fine paper, i.e. coated woodfree (Coated Wood Free) fine paper, in which operations take place on-line, especially suitable for a rebuild.

An object of the invention is to provide a method of upgrading a paper machine without adding length to the paper machine.

An object of the invention is to provide a method and a paper machine for the manu-

facture of fine paper in which the change of grade is fast. The fast change of grade allows short delivery times so that different paper grades can be produced at a higher production and cost efficiency (e.g. raw material savings etc.).

Furthermore, an object of the invention is to provide a method and a paper machine for the manufacture of fine paper allowing different profile control arrangements.

In connection with the invention, it shall be particularly noted that several of the techniques used in the method and in the paper machine in accordance with the invention have become known separately only quite recently in connection with different paper or board grades. In this invention, the inventor has realized the possibility of assembling from the new technologies a fine paper machine line which produces high-quality fine paper with good efficiency, lower operating costs and especially the possibility to combine these new technologies in upgrading a paper machine.

With a view to achieving the objectives stated above as well as those which will come out later, the method according to the invention is mainly characterized in what is set forth in the characterizing part of claim 1.

The paper machine line according to the invention is in turn mainly characterized in what is set forth in the characterizing part of claim 10.

The invention comprises of a more compact and novel way of building the structure of the coated paper to achieve the same target as for conventionally multiple coated papers. The vital parts of the invention can also be utilised to upgrade a papermaking line from surface sized to coated woodfree grades.

The invention utilises the possibility to initially reduce the openness of the base sheet structure through fiber and/or filler layering. Then, the sheet-forming step ensures excellent formation values and porosity levels. In the press section, the dewatering

will be done to ensure the web support, the evensidedness and a low web draw at the transfer to the drying section. The after-drying section will be equipped with impingement units to intensify and to make the drying process more compact. The precalendering process has previously been questioned regarding its necessity. Now, a novel way of reinforced precalendering the paper prior to coating utilises high surface temperatures of the thermo roll, possible a long nip and external/initial sheet moisture, which provide possibilities to close the sheet surface resulting from the gradient calendering. The elevated moisture is used to avoid too extensive drying of the sheet and to initiate a gradient calendering phenomena. By closing the sheet and creating a very smooth surface prior to coating, the coating color remains on the paper surface and evenly covers the base sheet. The smoothness development prior to coating leaves mainly the gloss development to be done in the final calendering step. The final calendering can be done with a multinip calender at high thermo roll temperatures and an even nip load distribution throughout the calender stack. The multinip calender applied in the invention is a calender with more than one calendering nip. The multinip calender has a tendency for drying the paper sheet due to high thermo roll surface temperatures in a high number of nips, for which reason a higher sheet moisture level going into the calender than conventional calenders is used. The moisture content of the sheet going into the calender is approximately 3 % higher than the target for the final sheet. Color sticking onto calender rolls becomes a problem at sheet moisture of 7–8 % for blade coated paper and 11–12 % for film coated. Thereby, the online surface treatment solutions based on film coating technology reduces the runnability risks in the calender.

The main process units and their functionality in the invented compact papermaking line according to a preferred embodiment of the invention are listed below;

1. Optimization of the short circulation operations (OptiFeed™)

- Short grade changes in respect to furnish composition and the short circulation

2. Multilayering technology with fiber or additives (OptiFlo™)

- Closes paper surface

3. Forming section with loadable blades (OptiFormer™)

- Improved formation potential

4. Press-section with supported web transfer (OptiPress™)

- Reduced web draw and eliminated risk for increased porosity.

5. Compact predrying section (OptiDry™ & HiRun™)

- High efficiency drying units at high temperature and air velocity.
- Process elements to support web transfer and reduce draw, which also reduces the porosity of the paper web

6. One or more reinforced-nip precalender (OptiDwell™, OptiGloss™, OptiSoft™)

- Large potential for evensidedness control, improved smoothness and closes surface
- High surface temperatures of the thermo rolls (≥ 250°C) and long reinforced-nip (≥ 30 mm).
- Possibilities for external sheet moisturising or a high initial sheet moisture prior to the nips.

7. Film coating unit with compact machine circulation (OptiSizer™)

- Superior coverage potential and extreme solids contents (≤ 80 %).
- Minimise risk for build-up on calender covers, e.g. allows higher moisture content (< 11 %) compared to blade (< 7–8 %) before going into calender stack.

8. Compact after drying section (TurnDry™ and PowerDry™)

- Compact and high efficient (high temperatures and air velocities) drying section.

9. Multinip calendering (OptiLoad™ or Janus)

- The polymer roll covers allows high surface temperatures.
- The nip loading system allows an even loading and control of each roll nip separately.

In the following the preferred choices of units for the paper making line according to advantageous embodiments of the invention are discussed in greater detail.

In accordance with the invention, layering of additives and fillers is used in a headbox instead of precoating carried out in a finishing section in order to reduce the pore size distribution in the surface layers of a paper web. When additives and/or fillers are introduced into the surface layers of stock, it is possible to provide, for example, a U-shaped thickness direction profile of the filler. In layering additives and fillers, the stock is divided into three different stock flows for surface layers and for a middle layer, each of which is supplied with desired additives and fillers, starch in particular, in order to provide different layer structures. When needed, additives and fillers can be fed into the stock flow from several different points or in several different stages. In accordance with an advantageous embodiment of the invention, fines can also be added. Moreover, in connection with the invention, it is possible to advantageously use layering of fibres, in which fibre stock is divided into separate components for the surface and middle layers such that a desired type of fibre stock is passed to a surface layer and to a middle layer, respectively. In addition, it is possible to use retention agents which bind the fillers and fines to the surface, which prevents them from being carried away from the surface layers along with water. The retention agent may also be supplied in layers.

As the headbox the invention uses the headbox marketed by the applicant under the trademark **OptiFlo**™ or a similar type of headbox, in which the basis weight profile can be controlled by consistency adjustment and the fibre orientation can be affected by adjusting the profile. In the headbox, it is possible to use layering, layering of additives or fillers, in respect of which reference may be made, for example, to the applicant's *EP patent 651 092.*

As the former is used a gap former which allows higher speeds than other types of formers and carries out dewatering on two sides, whereby symmetric paper is obtained. As one gap former of this kind may be mentioned, for example, the wire

section marketed by the applicant under the trademark **OptiFormer™** or a similar type of former, one of them having been described, among other things, in the paper read by *L. Verkasalo: Efficient Forming at High Speeds, XI Valmet Paper Technology Days 1998.*

The fine paper manufacturing line according to the invention makes use of extended nip pressing. A so-called shoe press provides good bulk and high dry solids and the lowest possible asymmetry in the web. When using, for example, the applicants double-felted **OptiPress™** press section, symmetric dewatering and a web having symmetric surface properties are achieved. When it is desirable to achieve high dry solids, it may be beneficial to replace one felt with a non-water-receiving fabric which transfers the web well, with a so-called transfer belt.

In the invention, the dryer section employs both cylinder and impingement drying, one of such dryer sections being described, for example, in the international patent application *PCT/FI98/00945*. Advantageously, for example, a dryer section marketed by the applicant under the trademark **OptiDry™** or a similar type of dryer section is used. In such a dryer section where impingement drying is used in addition to cylinder drying, the change of grade is quick because it takes considerably less time to change impingement drying parameters than to change the temperature of massive drying cylinders. Impingement drying also allows more efficient control of the moisture profile than conventional cylinder drying alone. A runnability component marketed by the applicant under the trademark **HiRun™** is adavantageously used to improve web transfer and allows a considerable reduction of draw between the press-section and the first drying group. The draw reduction provides a considerable reduction of paper web porosity.

In accordance with the invention in precalendering is used a one or more-reinforced nip precalender for example a precalender marketed by the applicant under trademark **OptiDwell™, OptiGloss™, OptiSoft™** or a similar type of calender is used. Also a 2- or 4-nip hot soft calender including moisturizing can be used.

In the fine paper machine line in accordance with the invention, precalendering is followed by film coating unit. The function of coating is to close surface and thereby considerably reduce the pore size to maintain the ink layer (~ 1 µm thick) on the paper surface. Pigment combinations can be used to improve optical properties of the paper surface. Layering serves as precoat and this layer as topcoat in the invention. In the coating, a film coating unit marketed by the applicant under the trademark **OptiSizer™** or a similar type of unit is used which also allows profile control of the amount of surface size / pigment. A compact machine circulation system marketed by the applicant by the trademark **OptiDoser™** can be used to considerable reduce the color flow to the film coater application units with up to 80 %. This allows faster and more flexible grade changes.

The coating is followed by a dryer section mainly applying contact-free drying, which allows a fast grade change. The contact-free drying is followed by a short cylinder group which in itself serves to affect primarily the stabilization of the travel of the web, the draw and tension of the web while the drying process is continued at the same time. The cylinder group may comprise single-wire or twin-wire draw, however, most advantageously single-wire draw. In connection with the contact-free drying, it is possible to use a drying arrangement marketed by the applicant under the trademark **TurnDry™**, **PowerDry™** or a similar type of drying in which the paper web is dried and turned by means of the same device, for example, by means of a combination of a turning device and an airborne web-dryer. This enables a fast grade change and, at the same time, assures stable running of the web.

After that, there is an on-line multi-nip calender, for example, a calender marketed by the applicant under the trademark **OptiLoad™** or a corresponding type of calender, which differs from conventional supercalenders in that its linear loads in each nip can be regulated separately. By this means, it is possible to conserve bulk, yet attaining good gloss and smoothness. With respect to this type of calender, reference is made to *FI patent 96334*.

The fine paper machine line ends in a reel-up. It is most preferably a reel-up marketed by the applicant under the trademark **OptiReel™** or the type of reel-up which produces low amounts of bottom broke and provides a roll of a high standard to ensure its problem-free further processing.

Suitable automatic and measuring devices are incorporated into the method and the paper machine for manufacturing fine paper in accordance with the invention, for example, for the purpose of determining and correcting longitudinal and cross direction profiles of the web or for the purpose of performing a fast grade change. As a measuring device is used, for example, a transverse beam which comprises several sensors or scanners and, at the same time, it is possible to measure machine direction variation, for example, by means of scanning devices.

In the invention, the possibility of profile control is ensured by the fact that profiling devices are used as devices. The basis weight can be profiled by adjusting the consistency in the headbox. In the press section, a steam box can be used for increasing and profile control of dry solids. Impingement drying allows profile control of drying. In the dryer section it is also possible to use a moistening device for profile control of dry solids, and in sizer types of coaters surface size / the amount of coating can be measured separately for each paper side which allows profiling of the color film. It is easy to combine profile control with non-web-contacting drying. When needed before precalender it is possible to use, for example, a moistering device which is based on steam or water mist.

In the following, the invention will be described in more detail with reference to the figures in the accompanying drawing, to the details of which the invention is, however, not by any means intended to be narrowly confined, nor is the invention intended to be limited only to this embodiment which is advantageous in itself.

The figure 1 schematically one example of a paper machine known in prior art.

The figure 2 schematically shows one example of a paper machine application in accordance with the invention.

The figure 3 schematically shows influence of forming concepts on woodfree base paper beta-formation and porosity.

In the figure 1 a conventional paper making line concept for double coated fine paper is shown. First stock is fed from a headbox 100' to a wire section 200', which is followed by a press section 300' with two press nips 350',360'. The web W' is passed from the press section 300' to a predryer section 400', in which single-wire draw groups R' and impingement drying 450' are used. In the application shown in the figure, the impingement drying units 450' are formed of a large-diameter cylinder 420' placed in a basement space and of an impingement drying apparatus 422' placed in connection therewith. The predryer section 400' is followed a calender 500' that is a hard or a soft calender. It is followed by a precoating station 600' based on film transfer applying roll application for surface sizing / pigmenting / precoating of the web, and by an after-dryer section 650', which is composed of a section 660 applying contact-free drying (infrared drying, airborne web-drying) and of a cylinder group 670'. After that, the web is coated in coating stations 700',800', in which one side of the web is first coated in the first coating station 700', which side is dried in a dryer unit 750' using contact-free drying 760', after which there is a cylinder group 770'. The other side of the web is coated in the second coating station 800', which is followed by a dryer section 850' which mainly applies contact-free drying 860', after which there is a short cylinder group 870'. This is followed by a multinip calender 900' in which the paper web is calendered so as to have desired gloss and smoothness. Finally, the web is reeled into rolls by means of a reel-up 1000'. The length L' of this concept according to prior art shown in this figure is approximately 169800 mm.

In the paper machine in accordance with a preferred solution of the invention as shown in the figure 2, the travel of the paper web W is as follows. The stock is fed

from the headbox 100 using multilayering technology with fiber or additives to the forming section with loadable blades into a gap between forming rolls 210, 220 of the gap former 250 of the wire section 200, from which it is passed between wires via the dewatering devices of the gap former 250 further to the press section 300 while supported by a wire. The press section 300 comprises two presses 350 and 360 and the web W is passed on an upper fabric of the first press, while supported by a lower fabric, so as to be between the press rolls of the press 350. From the lower fabric, the web W is passed onto an upper fabric of the next press 360 and further between the upper fabric and a lower fabric so as to be between the press rolls of the press 360. The web W is passed from the press section 300 to the dryer section 400, in which the web W is dried, while supported by drying wires, in the impingement drying groups 450 and in the drying groups R that apply single-wire draw. In the drying groups R applying single-wire draw, the reference numeral 415 designates the drying wire and the reference numeral 410 designates heated drying cylinders in an upper row and the reference numeral 411 designates reversing cylinders or rolls in a lower row. The web W runs meandering from the reversing cylinders/rolls 411 of the lower row onto the heated drying cylinders 410 of the upper row, on which the web W is in direct contact with the heated cylinder surface. The inpingement drying units 450 are formed of a large-diameter cylinder 420 placed in a basement space and of an impingement drying apparatus 422 placed in connection therewith. For the sake of clarity, the above-noted signs have been indicated only in connection with one drying group. After that, the web W is passed to the precalender 500 with two-reinforced calender nips 540,550. Rolls of the film coating unit 600 are denoted with the reference numerals 645 and 647 and the reference numerals 648 and 649 designate film transfer equipment of the coating unit. The web W is passed through a first contact-free drying and turning device 660 via a second contact-free drying device, for example, an infrared/airborne web-dryer 665 to the drying group 670 which applies single-wire draw and which comprises a drying wire 651 and heated drying cylinders 610 as well as reversing cylinders/rolls 611. After that, the web W is passed to the on-line multi-nip calender 900. After the calender 900, the web W is passed to the

reel-up 1000, in which the paper web W is reeled into paper rolls. The length L of this paper making line is approximately 143100 mm.

In the following table an example of the influence of roll-nip and shoe-nip precalendering on base paper properties is shown.

	Base paper	Roll-nip precalendering (soft/hard)			
Linear load (kN/m)		60	60	150	150
Surface temperature, steel roll (°C)		50	100	50	100
Density (kg/m^3)	585	685	691	721	731
Moisture (%)	4.2	4.1	3.6	3.9	3.6
PPS roughness, ts/ws (µm)	6.26/8.17	6.20/5.65	6.15/5.52	6.07/5.08	5.90/5.12
Bendtsen smoothness, ts/ws (ml/min)	510/710	505/400	509/385	510/250	515/260
Bendtsen air leakage (ml/min)	250	241	235	231	221
Cobb-Unger oil absorption, ts/ws (g/m^2)	21.0/16.5	20.1/14.2	19.5/13.6	19.9/14.3	19.4/13.1
	Base paper	Shoe-nip precalendering			
Linear load (kN/m)		200	400	400	400
Surface temperature, steel roll (°C)		200	200	290	290
Density (kg/m^3)	585	645	691	743	746
Moisture (%)	4.2	3.5	3	2.5	x
	10.1	x	x	x	x
PPS roughness, ts/ws (µm)	6.26/8.17	5.98/5.27	5.82/3.70	5.66/2.78	5.44/2.45
Bendtsen smoothness, ts/ws (ml/min)	510/710	505/230	440/198	425/191	408/198
Bendtsen air leakage (ml/min)	250	201	151	110	98
Cobb-Unger oil absorption, ts/ws (g/m^2)	21.0/16.5	19.4/13.5	17.9/11.6	16.1/8.2	15.1/6.5

In figure 3 is shown influence of forming concepts, e.g. loadable blade (LB) and multifoil shoe (Shoe) units on woodfree base paper beta-formation and porosity. The porosity on x-axis and on y-axis is beta-formation and with black squares are shown results with loadable blade units and with grey squares loadable blade roll furnish and with grey squares with x are shown multifoil shoe units.

Above, the invention has been described only with reference to one of its advantageous embodiment examples, to the details of which the invention is, however, not intended by any means to be narrowly confined. Many variations and modifications are feasible within the inventive idea defined in the following claims.

Claims

1. A method for the manufacture of paper, in particular of coated fine paper, in which method paper stock is fed from a headbox (100) to a wire section (200) in which water is drained from a paper web (W), in which method the paper web (W) is passed from the wire section (200) to a press section (300) to press water out of the paper web (W), and in which method, after the press section (300), the paper web (W) is dried in a dryer section (400), precalendered and coated in a coating station (600), after which the paper web (W) is dried in a drying section (650) and calendered in a final calender (900), and reeled in a reel-up (1000), **characterized** in that in the method

- the stock is fed into the headbox (100) using multilayering technology,
- the paper web (W) is precalendered in a one or more reinforced-nip calender (500),
- the paper web (W) is coated in a film coating unit.

2. A method according to claim 1, **characterized** in that the method is used in upgrading a conventional paper making line for making surface sized paper to a paper making line for making coated woodfree paper.

3. A method according to claim 1 or 2, **characterized** in that in the method

- the stock is fed into the multilayering headbox (100),
- in the wire section (200), water is drained from the paper web (W) in a forming section with loadable forming units,
- in the press section (300), the paper web (W) is supported,
- from the press section (300) to and in the first drying group, the web transfer is supported,
- in the dryer section (400), at least part of the drying of the paper web (W) is carried out by means of impingement drying (450),
- the paper web (W) is precalendered in a one or two reinforced-nip calender (500),

- the paper web (W) is coated in a film coating unit,
- after coating (600), the paper web (W) is dried by means of contact-free drying (660), and
- the paper web (W) is calendered in a multinip calender (900).

4. A method according to claim 1, **characterized** in that two felts or a felt and a transfer belt are used in the press nips in the press section (300).

5. A method according to claim 3, **characterized** in that, in the method, combinations of impingement drying and cylinder drying or non-web-contacting drying and cylinder drying are applied to the drying of paper in order to accomplish a fast grade change.

6. A method according to claim 3, **characterized** in that, in the method, a moistening device based on steam or water mist, placed before the precalender (500), is used.

7. A method according to claim 3, **characterized** in that, in the method, the principal drying in the after-drying units is carried out without contact with the web.

8. A method according to claim 1, **characterized** in that, in the method, linear loads of 100–750 kN and temperatures ≥250°C of the thermo rolls and ≥30 mm long show nip are used in the calender (500).

9. A method according to claim 1, **characterized** in that in the method film coating with compact color circulation is used.

10. A paper machine line in particular for the manufacture of coated fine paper, which line comprises a headbox (100), a wire section (200), a press section (300), a dryer section (400), a precalender (500), a coating station (600) and drying section (680), a final calender (900) and a reel-up (1000), **characterized** in that the paper

machine line comprises multilayer headbox (100), a one or more reinforced-nip precalender (500), a film coating station (600).

11. A paper machine line according to claim 10, **characterized** in that the paper machine line is an upgraded paper machine line for making coated woodfree paper.

12. A paper machine line according to claim 10, **characterized** in that the on-line calender is a multi-nip calender.

13. A paper machine line according to claim 10, **characterized** in that the wire section is a gap former.

14. A paper machine line according to claim 10, **characterized** in that in the press nips of the press section there are two felts or a felt and a transfer belt.

15. A paper machine line according to claim 10, **characterized** in that its drying sections (400,600) comprise as a combination both cylinder drying and impingement drying or cylinder drying and non-web-contacting drying.

16. A paper machine line according to claim 10, **characterized** in that the after-drying sections (600,750,850) have been so dimensioned that principal drying takes place without contact with the web.

17. A paper machine line according to claim 10, **characterized** in that the paper machine line comprises a moistening device based on steam or water mist, placed before the precalender (500).

18. A paper machine line according to claim 10, **characterized** in that the paper machine line comprises film coating unit with compact color circulation system.

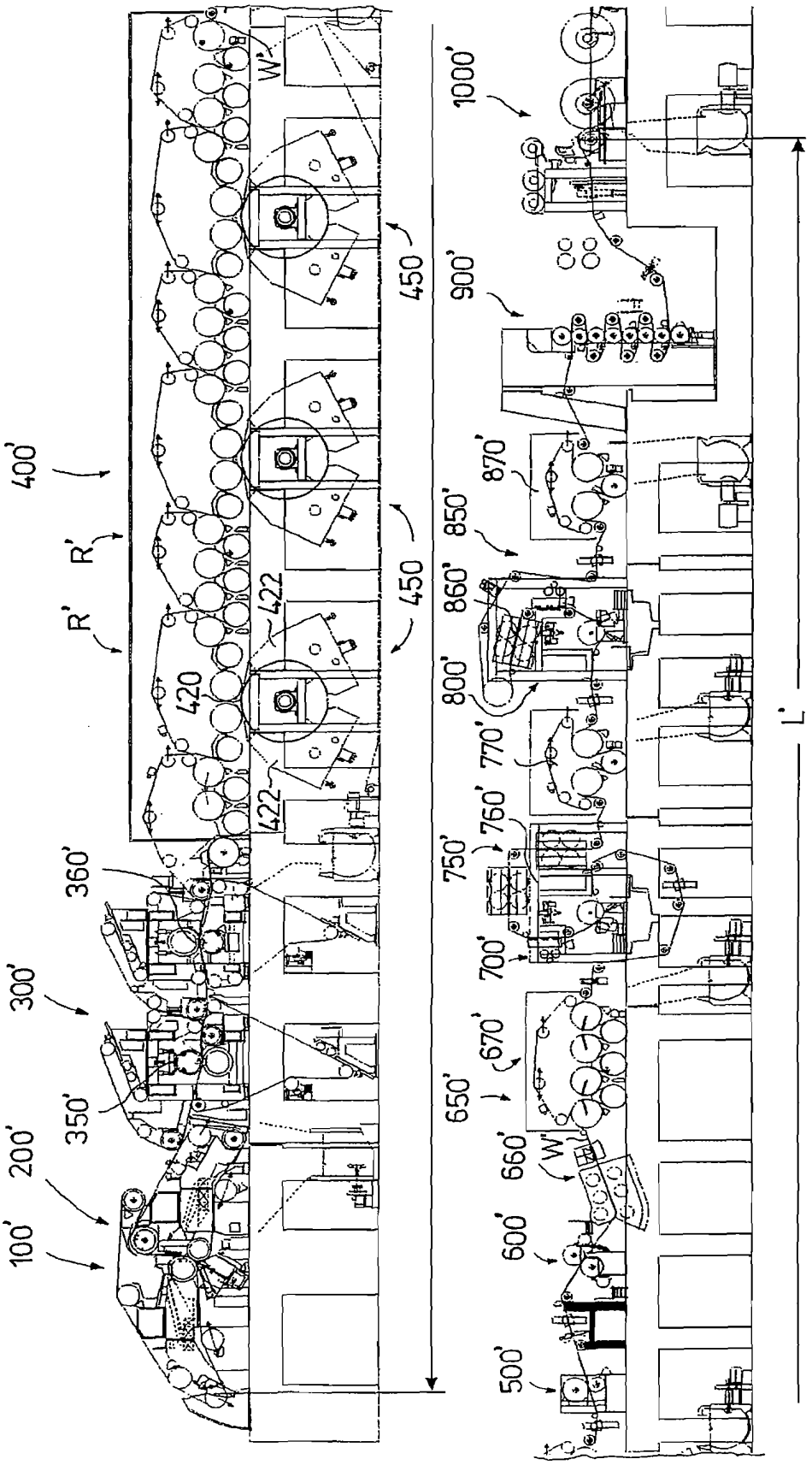

FIG. 1 PRIOR ART

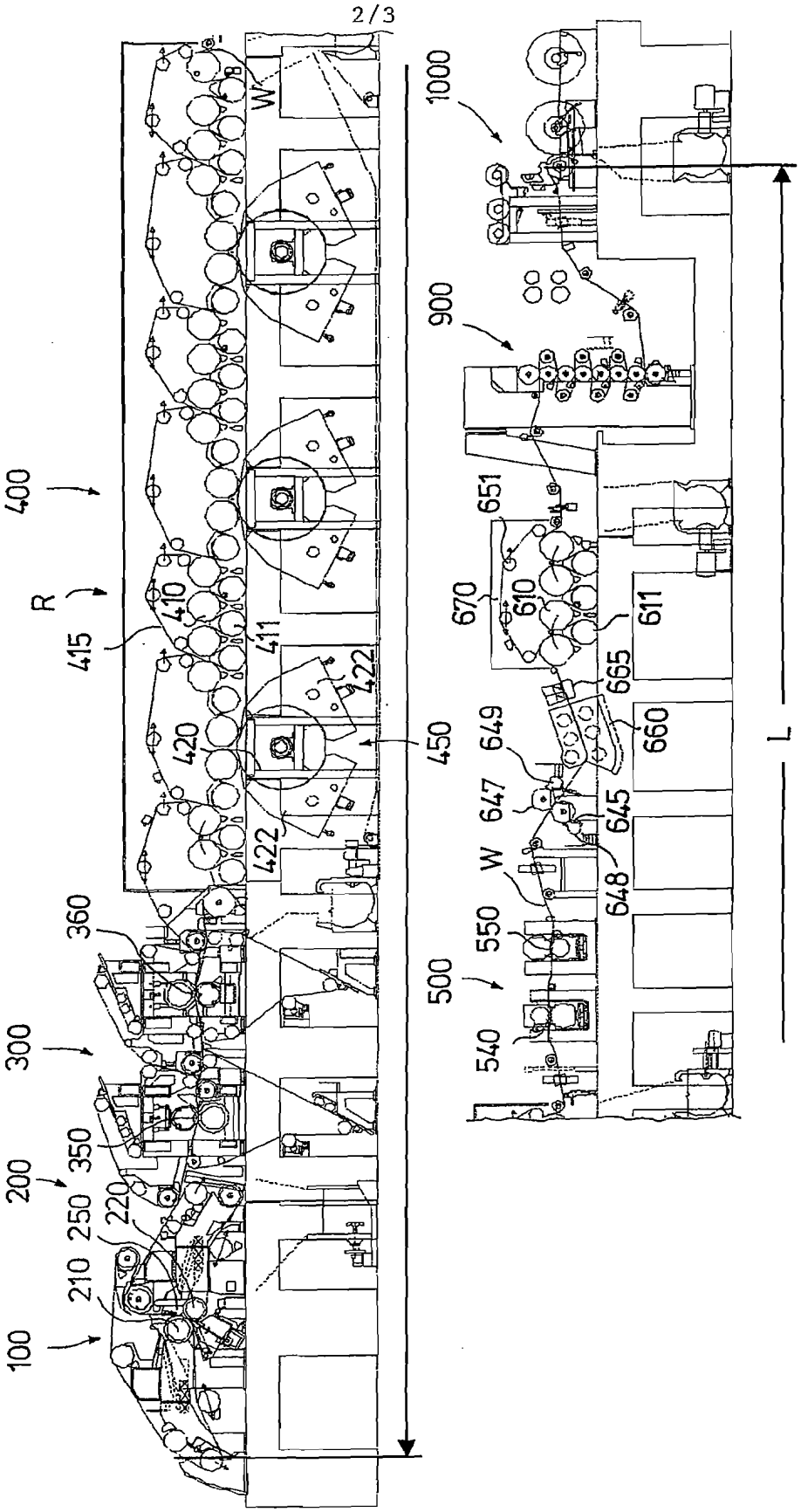
100
200
210
250
220
350
300
360
400
R
410
415
411
422
420
422
450
500
550
540
W
647
649
645
648
660
665
670
610
611
651
900
1000
L

FIG. 2

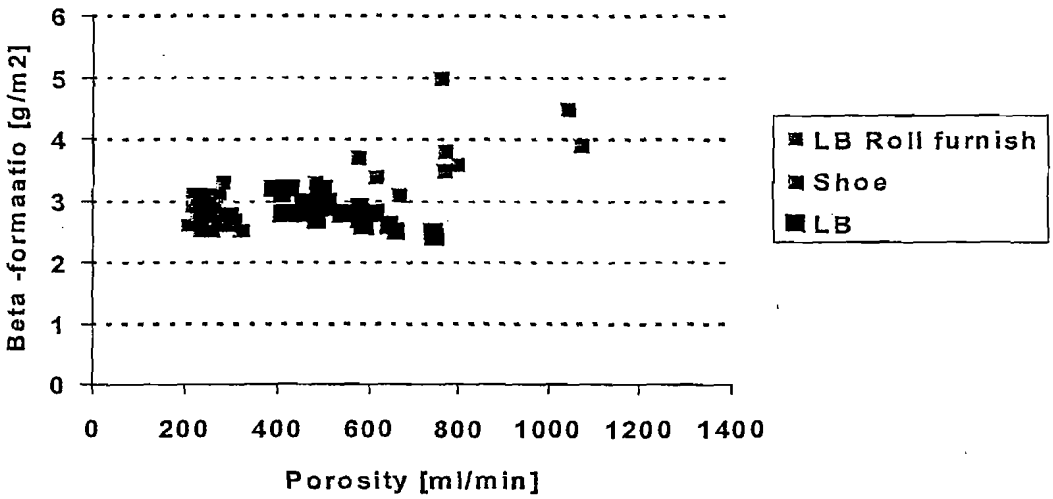
Beta -formaatio [g/m2]
0
1
2
3
4
5
6
0
200
400
600
800
1000
1200
1400
Porosity [ml/min]
LB Roll furnish
Shoe
LB

FIG. 3